# EARLY CHILDHOOD SCIENCE EDUCATION TRENDS IN TURKEY: WHERE FROM? WHERE TO?

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## Abstract

*The current study intends to review both all empirical and theoretical research for understanding and discussing the trend in early childhood science education in Turkey. A summative content analysis was conducted with a total of 136 studies including 69 graduate theses (master thesis and dissertations) and 67 journal articles published from 1999 (the beginning) to the mid-2017. Data were extracted from the full-text of articles and the theses by visiting the websites of the journals and the related databases. The search keywords mainly included the terms: early childhood, preschool, science. The studies were analyzed in terms of publication year, author collaboration, research topics, research methods, and target population. The results revealed that the number of graduate theses and articles in the field of early childhood science is continuously growing. It was identified that collaborative research efforts in early childhood science education was a leading design on the published work. Results determined that a vast majority of the papers used quantitative research methods, mainly conducting surveys and using experimental design. Children, early childhood teachers and prospective teachers were the most common study subjects in the selected papers. The research topics of environmental education, scientific process skills, teaching methods, attitudes and behaviour were received relatively more attention among researchers.*

**Keywords**

Early Childhood, Science Education, Research Trends

## 1. Introduction

> *"Children will generally say that the stone will sink because it is heavier than water. The stone does sink, but is it really heavier than the water? To check, the teacher places the stone on one side of the balance scale and the water, removed from the container and transferred to a plastic bag, on the other. Seeing that the water is heavier than the stone, the students must face the fact that the stone sinks even though it is lighter than the water. From here, the teacher places the stone inside a balloon without inflating it, ties it so that no water can get inside, and asks what will happen to the stone with the balloon if we put them inside the water. The balloon with the stone will sink. However, if we inflate the balloon while the stone is inside, the stone-balloon combination will float. The experiment is effective because the weight variable is kept, more or less,*

*constant (in fact, of course, the weight increases slightly!) while the volume changes dramatically. Exposing children to the possibility that not only the weight of an object, but also its volume, may determine whether or not an object sinks or floats, paves the way, we believe, to the concept of density and will make it easier to grasp when introduced formally in student's later studies"*
(Eshach, 2006, p.24).

There is a growing understanding and recognition of the power of children's early thinking and learning as well as a belief that science may be a particularly important domain in early childhood, serving not only to build a basis for future scientific understanding but also to build important skills and attitudes for learning (Worth, 2010). As presented in the case above, exposing children to science activities early on has been emphasized by a multitude of research (Eshach, 2006; French, 2004; Ginsburg & Golbeck, 2004; Lind, 1999).

Just like scientists, children in early years often inquire, observe, predict, infer, collect data and constantly wonder about the world around them. In order to support children's development and satisfy their curiosity, the learning environments should allow them to use their five senses, conduct research and discuss ideas. Research in cognitive and developmental psychology highlights the importance of a stimulating learning environment as well as the negative influences on children's cognitive development lack thereof (Hadzigeorgiou, 2002). Formal and informal science learning opportunities presented to children in preschool improve their later science achievement and help them develop science process skills and positive attitudes towards science and nature.

According to the literature, the rationale for teaching science in early years is twofold. "Science is related to the real world" and "Science improves reasoning skills" (Gelman & Brenneman, 2004; Zimmerman, 2000). The first aspect points to the understanding main science concepts and the second aspect highlights the importance of science education for developing reasoning skills. The reasoning skills are necessary for not only understanding science but for being successful in other fields. Eshach and Fried (2005) stated that teaching science should not be in the form of simple observations and experiments. Rather, interactive, inquiry-based and challenging science learning environments should be created in order to develop both science concepts and process skills in children. Moreover, they listed the reasons why children should learn science. Accordingly, (1) Children tend to observe and think about the natural world; (2) Science helps children develop positive attitudes towards nature; (3) Introducing science

concepts early to children helps them understand science easier in the future; (4) The use of scientific language in early years positively influences science understanding; (5) Children are capable of reasoning and critical thinking and (6) Science is an effective tool in developing scientific thinking (pp. 332-333). By learning science, children can develop other important skills, such as working with one another, basic large- and small-motor control, language, and early mathematical understanding (Worth, 2010). Another important aspect of science education is using scientific language. Using scientific language is important for not only comprehending science concepts but also developing a scientific way of thinking and research skills (Zhang et al., 2010).

Children are born with intrinsic motivation to do science. In other words, even if they do not receive any formal science education, they already show effort to understand the world around them. However, children need guidance and structure to turn their natural curiosity and activity into something more scientific (Worth, 2010). If children do not receive guidance from their parents and teachers or if their questions are ridiculed and unanswered, they are likely to lose their interest towards science and they would accept the things as they are. Moreover, if their questions are not addressed they might develop misconceptions on scientific issues. Having scientific understanding and positive attitudes towards science are particularly important for societal development and wellbeing. Individuals with such traits help societies become successful in various fields such as industry, technology, health and education (Genç Kumtepe, 2008).

Teaching and learning science is accepted as an essential element but it is often an overlooked aspect of young children's educational experience. It should be noted that science teaching in early childhood does not refer to transferring scientific knowledge, but rather providing opportunities for kids to learn such knowledge and skills through hands-on and minds-on learning activities as they make sense of their world (Duschl, Schweingruber, & Shouse, 2007; Samarapungavan, Mantzicopoulos, & Patrick, 2008). Science activities at this level should arouse interest and curiosity and serve children to improve their analytical and critical thinking as well as problem solving skills.

In recent years, early childhood education has gained utmost significance in Turkey in efforts to improve education. Unfortunately, science is the most ignored subject in this stage of education. The current study is an attempt in understanding the trends of science education in the early years in Turkish context. The purpose of this study is to review all the national level

research from the beginning, including theses, dissertations and articles in the field of early childhood science education. By doing so, it was aimed to capture the essence of research and to summarize the trends in Turkey by employing content analytical procedure. Academics and professionals will find the results of this study valuable in developing new research agendas and teaching and learning strategies. It is also believed that the findings of this study at the national level would provide a comparable data for evaluating cross-cultural trends in the field.

## 2. Method

The current study examines and summarizes trends in Turkish early childhood science education (ECSE) research over the last two decades (1999-2017) by using a summative content analytic approach. Content analysis is used for understanding "...the content of data (verbal, text, audio, etc.) through the objective and systematic classification process of coding and identifying themes or patterns. Specifically, a summative content analysis involves "...counting and comparisons, usually of keywords or content, followed by the interpretation of the underlying context (Hseih & Shannon, 2005; pp. 1277-1278). It enables a detailed evaluation and reduction of massive qualitative information into a smaller and more manageable form of quantitative information. During this process, the sequential steps were carried out: (1) selection of papers (journal articles & graduate thesis); (2) application of the pre-set coding schema; (3) developing themes for research topics; (4) analyzing and organizing outcomes, and (5) interpretation of findings.

### 2.1. Paper Selection Process

Considering the nature of our study, we need to cover all of the research in the field of interest published from the beginning. Instead of reviewing any specific journal, the database search was performed using certain keywords (science education, early childhood, preschool, kindergarten, etc.). Once the list of papers was retrieved, the studies were examined for relevance to ensure that the paper met the inclusion criteria. The main criteria were the language, the context of the study, and the scope of the papers. The language of the papers should be written in Turkish or English. The study should be carried out in the Turkish educational context even if an international collaboration was formed during the study. Finally, the scope of the paper should be related to early childhood science education.

In order to map the state of academic knowledge in ECSE over time, theses and articles from the beginning to mid-2017 formed the subject for this study. At the end of the paper

screening process, a total of 136 research papers (excluding introductory statements, editorials, and book reviews) were extracted for the current study.

## 2.2. Coding Phase

A coding schema was applied to evaluate the selected papers based on the framework of this study. The coding schema includes type of research paper, type of graduate thesis, publication year, and number of authors, study subjects, research topics, and research methods. The selected papers were coded by two researchers who have expertise in the field of early childhood and science education. Each researcher coded documents independently. In order to ensure inter-coder reliability in this process, the coders separately repeated each other's work and then Cohen's Kappa's statistics (κ) was calculated (Cohen, 1960) to evaluate inter-coder agreement. Kappa values less than 0.21 indicate low agreement, 0.21- 0.40 reasonable, 0.41-0.60 moderate, 0.61-0.80 substantial, and more than 0.80 refer to excellent agreement (Rietveld & van Hout, 1993). Inter-coder/researcher agreement for the current study ranged from 0.62 to 0.85, indicating considerably moderate/high agreement among the separate entries. The results from content analysis are presented with descriptive statistics including frequencies and percentages.

# 3. Results

## 3.1. Publication Type

A total of 134 research publications were retrieved from the selection process. Of 65 were research articles and 69 graduate theses including master's theses and dissertations conducted in a variety of institutions in Turkey (Table 1).

**Table 1:** *Frequency of Publication Type*

|  |  | Frequency | Percent |
|---|---|---|---|
| Article |  | 65 | 48.5 |
| Graduate Theses | Master's | 53 | 39.6 |
|  | PhD | 16 | 11.9 |
| Total |  | 134 | 100.0 |

Figure 1 summarizes the publications' frequency over time. There is clear evidence that an increasing trend was identified in the number of annual publications in early childhood science education research during the period of 1999–the mid-2017. Similar trend was observed in Master's thesis and dissertations. In Table 1, there are noticeable positive trends in the frequency

of graduate studies in the field. This result presumably indicates that early childhood science education became a noticeable field of research.
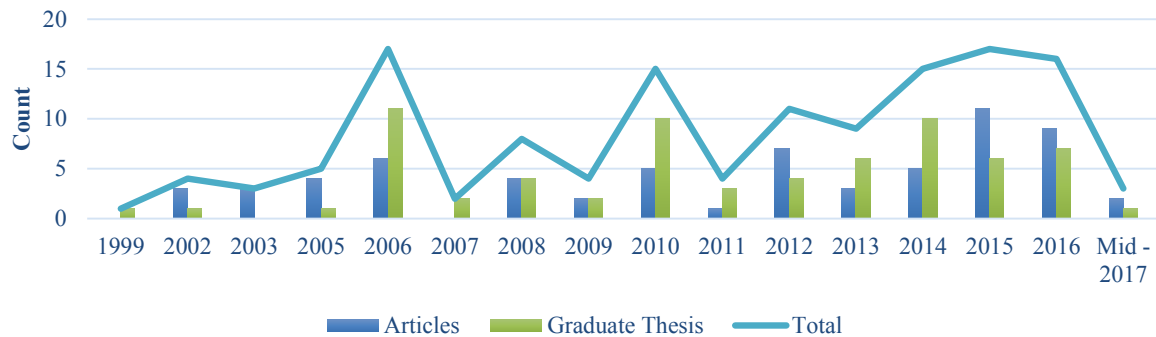


**Figure 1:** *Distribution of Research Papers by Publication Type (1999-2017) (n=134)*

### 3.2. Trends in Solo vs. Collaborative Research

In order to examine teamwork efforts in the research studies, the number of authors in each article was counted. The frequency distributions of single-and multiple-authored articles by year were displayed in Table 2. In this process, a total of 18 (28%) single-authored articles and of 47 (72%) multiple-authored research papers were extracted.

**Table 2:** *Number of Authors in Research Articles across the Years (n=65)*

| | Number of Authors | | | | | Total (2–5*) |
|---|---|---|---|---|---|---|
| Year | 1 | 2 | 3 | 4 | 5 | n |
| 2002 | 1 | 1 | 1 | 0 | 0 | 2 |
| 2003 | 2 | 0 | 1 | 0 | 0 | 1 |
| 2005 | 2 | 1 | 1 | 0 | 0 | 2 |
| 2006 | 1 | 5 | 0 | 0 | 0 | 5 |
| 2008 | 0 | 3 | 1 | 0 | 0 | 4 |
| 2009 | 0 | 2 | 0 | 0 | 0 | 2 |
| 2010 | 1 | 4 | 0 | 0 | 0 | 4 |
| 2011 | 0 | 0 | 1 | 0 | 0 | 1 |
| 2012 | 4 | 1 | 1 | 1 | 0 | 3 |
| 2013 | 0 | 1 | 2 | 0 | 0 | 3 |
| 2014 | 1 | 3 | 1 | 0 | 0 | 4 |
| 2015 | 3 | 6 | 2 | 0 | 0 | 8 |
| 2016 | 3 | 3 | 1 | 1 | 1 | 6 |
| Mid-2017 | 0 | 2 | 0 | 0 | 0 | 2 |
| **Total n** | **18 (28%)** | **32** | **12** | **2** | **1** | **47(72%)** |

The yearly variations also indicate that the highest level of solo studies was conducted in 2012 with four articles whereas the highest collaborative research was published in 2015 with 8 studies. There is a clear sign that collaborative research in early childhood science education was valued after 2005 (see Figure 2).
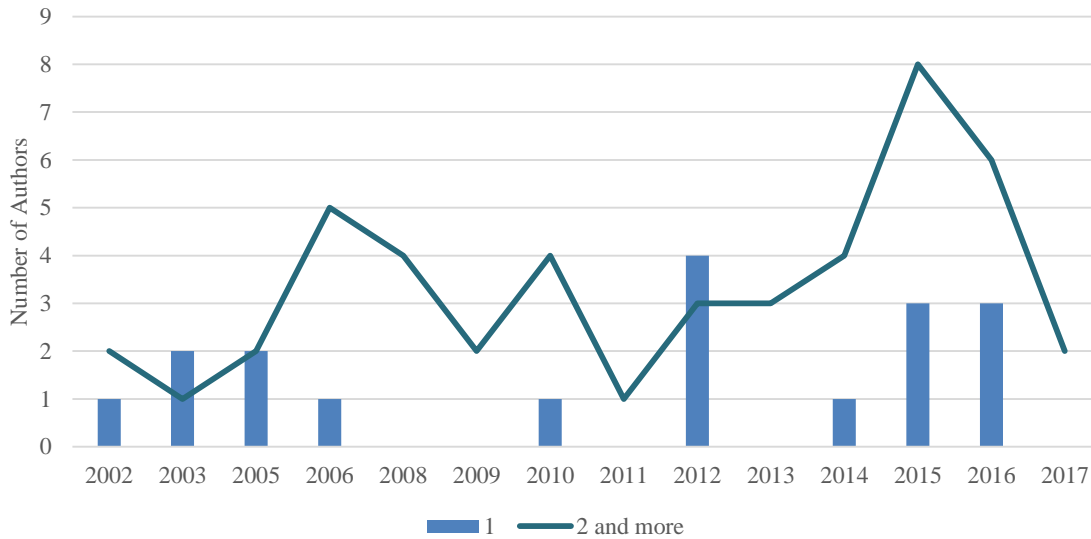


**Figure 2:** *Solo vs. collaborative research (2002-2017) (n=65)*

We believe that teamwork may create a learning culture especially for individuals from different fields and different countries and also it may be useful in stimulating research productivity and capability.

### 3.3. Study Subjects

An analysis of study subjects in each paper revealed that children (prescholars, 36%), early childhood in-service teachers (32%), and pre-service teachers (19%) were more commonly studied throughout the years (Figure 3). Documents including web-sites, teachers' plans, curricular materials etc. were the next popular data. Very few studies (8%) collected data via parents, academic staff and principals of early childhood schools.
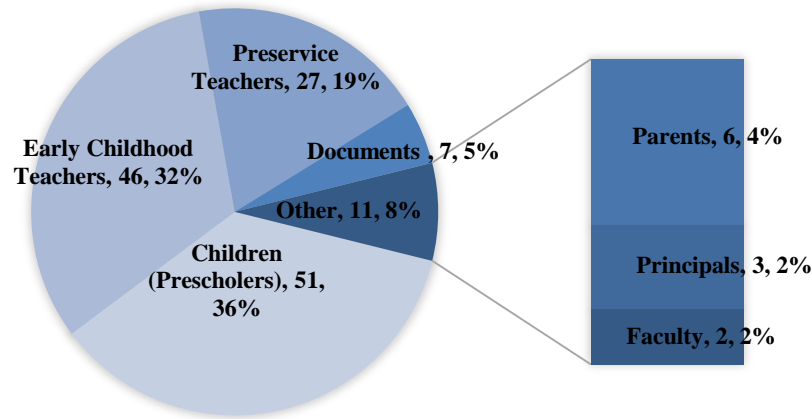
**Figure 3:** *Distribution of study subjects*

## 3.4. Trends in Research Methods

Three main research methods are common in social sciences as quantitative, qualitative, and mixed method approaches. Moreover, review papers were classified in another category as theoretical studies. Findings summarized in Table 3 signified that empirical research was the most common in early childhood science education research. Only 12 papers (9 articles & 3 theses) were non-empirical studies in nature. Among these publications, quantitative research ($n_{quan}$=76; 56%) was most widely used approach comparing to qualitative ($n_{qual}$=29) and mixed methods ($n_{mixed}$=76) during that period.

**Table 3:** *Research Methods*

| Year | Articles | | | | Graduate Theses | | | |
|---|---|---|---|---|---|---|---|---|
| | Quan | Qual | Mixed | Theor | Quan | Qual | Mixed | Theor |
| 1999 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 2002 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 |
| 2003 | 1 | 0 | 0 | 2 | 0 | 1 | 0 | 0 |
| 2005 | 2 | 0 | 0 | 2 | 9 | 1 | 0 | 1 |
| 2006 | 5 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 2008 | 0 | 3 | 1 | 0 | 4 | 0 | 0 | 0 |
| 2009 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 |
| 2010 | 3 | 1 | 0 | 1 | 7 | 3 | 0 | 0 |
| 2011 | 1 | 0 | 0 | 0 | 2 | 0 | 1 | 0 |
| 2012 | 4 | 1 | 1 | 1 | 2 | 0 | 1 | 1 |
| 2013 | 1 | 1 | 1 | 0 | 3 | 2 | 1 | 0 |
| 2014 | 4 | 1 | 0 | 0 | 3 | 2 | 4 | 1 |
| 2015 | 6 | 3 | 2 | 0 | 5 | 0 | 1 | 0 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2016 | 2 | 4 | 1 | 2 | 5 | 2 | 0 | 0 |
| Mid-2017 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 0 |
| **Total** | **31** | **17** | **8** | **9** | **45** | **12** | **9** | **3** |

Within the quantitative research trend, survey and experimental designs had great importance. Even though the quantitative research studies were the dominant, qualitative and mixed method research showed an increasing trend with years.

### 3.5. Research Topics

Results indicated that a vast majority of the papers are in teaching and learning methods, science content knowledge, science process skills, attitude and opinions on science, and assessment and evaluation content areas as a focus of the papers stayed relatively the same over the years.

*Teaching and learning* realm captures integrated approach (drama, music, physical education etc.), inquiry learning, constructivism, museum education, outdoor education, multiple intelligence, and project approach. S*cience content knowledge* for example includes physical science (astronomy) and life science (respiratory systems, environmental education) topics. Specifically, the research had a greater focus on environmental education comparing to other science areas. Developing *science process skills* is one of the popular topics over time. There are many suggestions for what science process skills early childhood students should learn and experience. *Attitudes and opinions toward science* is also observed as a trendy topic in this review. Many studies were assessed both in-service and preservice teachers' opinions and practices in science and also students' attitudes towards science education. Assessment and evaluation is extracted as common theme in early childhood science education in Turkey. This theme refers to students' assessment, program education and developing or adapting measurement instruments. Finally, few studies focused on the topics including professional development related activities and programs and parental involvement in science education.

## 4. Conclusion

A rapid growth in early childhood education has occurred in Turkey in recent years. Research claims that investment in early years' education reduces the costs in later years as well as increases academic achievement. Therefore, goverments around the world increased spending

in early childhood education (Garvis, Lemon, Pendergast, & Yim, 2013). As well as spending, research in the area also increased exponentially.

This content analysis sheds some light on the trends in early childhood science education in Turkey in the last 20 years. Researchers may find the areas of interest based on the findings; or, cross-cultural analyses may be conducted comparing Turkish contexts with other cultures. In their content analysis, Kara and Sengul (2016) analyzed a total of 55 studies on early childhood science education between the years 2000-2014. The current study provides a more extended analysis in terms of the number of studies. A total of 136 studies including 69 graduate theses (master thesis and dissertations) and 67 journal articles published from 1999 to the mid-2017. Data were extracted from the full-text of articles and the theses by visiting the websites of the journals and the related databases. The studies were analyzed in terms of publication year, author collaboration, research topics, research methods, and target population.

The results showed that the number of graduate theses and articles in the field of early childhood science is continuously growing. This growth is apparent especially, between 2014 and 2017. It was identified that collaborative research efforts in early childhood science education was a leading design on the published work. This finding makes sense considering science education in early childhood requires the expertise of early childhood educators and science educators.

The results also determined that a vast majority of the papers used quantitative research methods, mainly conducting surveys and using experimental design. This finding was in line with the previous trend studies on early childhood science education (Kara & Şengül, 2016; Moon, Cheong, Park, & Cho, 2012). Children, early childhood teachers and prospective teachers were the most common study subjects in the selected papers. This finding was also similar to those of previously mentioned.

The most commonly studied science content was environmental education in early years. As Davis (1998) argued, the topics on environment are commonly taught at the secondary school level and beyond and it is often ignored in pre-school. That might be the reason why researchers focused on this topic. Other commonly studies research topics included science process skills, teaching methods, attitudes towards science.

One of the immediate areas of development from these findings seems that more qualitative research needs to be conducted in the field of early childhood science education. More observational studies that investigate children's construction of science knowledge,

teacher-student interaction and science classroom discourse can be designed. Furthermore, science content other than environmental education, such as life science and physical science within the context of early childhood could be examined.

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